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ABSTRACT

The role of affect in course enrollment decisions and achievement are examined. First, sex differences in the affective reactions believed to mediate student's course enrollment decisions are examined for magnitude and consistency. Then, to gain a better sense of their relative influence in the achievement process, the importance of these responses is then assessed in relation to other attitudinal factors. Variables selected for this analysis included students' self-concept of math ability, their perceptions of the usefulness and importance of math, and their perceptions of their socializers' attitudes and expectancies. Results suggest that the role of sex differences in achievement-related affect has perhaps been overemphasized. While there was a tendency for girls to feel more negative toward math, gender differences were neither as strong nor large as indicated by previous research. (Author/GK)

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Sex Differences in Achievement-Related Affect

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Presented as a part of a symposium on "Sex Differences in Achievement Motivations: Where Are We Now?" at the Annual Meeting of the American Educational Research Association in Los Angeles, April 1981. The research reported herein was supported by grants from the National Institute of Education (NIE-G 78-0022) and the National Institute of Mental Health (5 ROI-MH 31724-01), while author was a graduate student at The University of Michigan.

Since the publication of Maccoby and Jacklin's book, The Psychology of Sex Differences, considerable attention has been directed toward understanding the psychological barriers inhibiting women from fully expressing their achievement potential. Women's strong fear of failure and the negative affective reactions associated with this such as uncertainty, worry, and anxiety are believed to create important barriers and account for their relative lack of achievement in areas where men typically excel.

This argument has recently been extended to the area of mathematics achievement. It is not uncommon for researchers and teachers to suggest that girls do not excel and achieve in mathematics because they suffer from what has become popularized as "math anxiety." Women are described as having more negative feelings toward math than men, reporting greater dislike, anxiety, and concern about their performances in mathematics. They are also described as having less confidence in their math abilities and less perceived control over their math achievement. It is argued by several researchers that these reactions, if present, would not only inhibit women's performance in math, but also lead them to avoid an area of achievement they found anxiety provoking. Both of these consequences would substantially limit women's achievement in mathematics, especially if they occur early in their school career.

Only moderate support for these proposals can be found in the research literature on the affective outcomes of mathematics learning. In terms of general affective responses, expressed as a liking and preference for mathematics, few differences are evident in boys' and girls' responses during elementary and high school. Sex differences in these variables do appear after high school, with males expressing more

positive affect toward math (Aiken, 1976; Ernest, 1976, Fox, Note 1). Turning to more extreme responses, in this case expressed as anxiety or excessive worry and concern, the view that greater numbers of females are math anxious is supported by only a few empirical studies (Brush, 1978; Dreger & Aiken, 1957; Suinn & Richardson, 1972). It is of some concern, however, that these studies have not examined the magnitude and consistency of these differences in younger populations, as many of these studies were completed on college students. Therefore, we know very little about the origins of math anxiety, though researchers have not hesitated to speculate about its many causes. In addition, the relative significance of affective reactions as an explanation of differential achievement and course enrollment in mathematics has not been adequately assessed.

Using a sample of 250 junior and senior high school students, the present study examines more closely the role of affect in course enrollment decisions and achievement. First, sex differences in the affective reactions believed to mediate student's course enrollment decisions are examined for magnitude and consistency. Then to gain a better sense of their relative influence in the achievement process, the importance of these responses are then assessed in relation to other atttudinal factors. The variables selected for this analysis included students' self-concepts of math ability, their perceptions of the usefulness and importance of math, and their perceptions of their socializers attitudes and expectancies. Past research has shown that these factors are also important mediators of students' academic decisions and achievement in mathematics (Armstrong & Kahl, 1980; Brush, 1980; Sherman & Fennema, 1977; Sherman, 1980; Parsons, et al., 1980; Steel & Wise, Note 2).

Description of Sample

The present study was conducted in a small middle to upper middle class community in Michigan. Approximately 250 fifth through eleventh grade students volunteered to particpate in the study. The sample included approximately the same number of boys and girls, with girls making up 52% of the sample.

Students were selected using the mathematics classroom as an intermediate sampling unit. A larger number of junior high school classrooms were chosen since past research indicated that the junior high school years were critical times for changes in students attitudes toward mathematics. In selecting these classrooms, special attention was given to choosing classrooms in which the mathematics curriculum was at grade level or slightly advanced. In contrast, elementary classrooms in this community were not grouped according to math ability; therefore, these classes were typically more heterogeneous than the junior and high school classes.

Description of the Measures

The Student Questionnaire was originally designed to assess a number of attitudinal variables believed to influence and mediate students course enrollment plans in mathematics (see Parsons et al., 1980). Several questionnaire items were constructed to measure the attitudinal and affective factors influencing course decisions. A majority of these items were 7-point bipolar rating scales anchored at the extremes with short verbal descriptions. These items were pilot tested on a sample of school children in a nearby area, comparable in most respects to the intended sampling area.

The following scales of questionnaire items were selected for analyses in this study:

Perceived ability: self-ratings of ability and performance in current mathematics courses.

Perceived value: ratings of the importance and usefulness of current and advanced mathematics courses.

Perceived socializers attitudes: student ratings of their parents and teachers attitudes regarding their (the student's) math abilities and performance expectations.

Dislike: ratings of subject matter liking and enjoyment.

Unsure: ratings of confidence in learning mathematics.

Worry: ratings of degree of worry and concern experienced related to mathematics performance.

Anxiety: ratings of degree of uneasiness, frustration, and helplessness experienced related to math performance.

Intent: ratings of the number of math courses students intended to take in high school.

Based on pilot data, the attitude and affect scales analyzed in this study were judged to adequately represent the dimensions being assessed and to have acceptable psychometric properties. Special attention was given to the internal consistency of the scales and only those scales with a Cronbach Alpha Coefficient of .60 were selected for analyses.

An index of student's current and past math performances was used in some of the analyses reported in this study. These data were taken directly from the student's school file. To form an estimate of each student's past performance in mathematics, all available math achievement scores (Michigan Assessment Test and California Achievement Test) and math grades two years prior to the study were standardized and averaged within grade.

Results

The first set of analyses assessed variations in students' affective reactions to mathematics due to gender. The mean ratings given by students on each of the four anxiety scales are presented in Figure 1. As this figure shows, scores on these scales are relatively low for this sample. Also, the distribution of scale scores were generally skewed toward the positive (low) end of the scales, especially for those scales asking students to indicate a more extreme reaction toward math such as fear and frustration. For example, seventy-seven percent of the sample received a score of four or below on the Anxiety Scale, while fifty-three percent received the same scores on the Worry Scale.

While as a whole, students report relatively positive feelings towards math, Figure 1 also shows that female students reported slightly higher levels of dislike, worry, lack of confidence, and anxiety. Only the sex difference found in students' ratings on the anxiety was statistically significant, however [$F=6.70(1,248), p<.01$]. It is important to emphasize that this difference represented, on the average, less than one point in their ratings of the items included in this scale. Therefore, little importance is placed on this finding until the significance of this difference in explaining sex-differentiated achievement behaviors in math is examined.

Is the variance in students' self-reports of anxiety primarily due to gender differences? To address this question, regression analyses were employed to assess the influence of gender on affective reactions in relation to other attitudinal variables of interest: perceived

ability, perceived value, perceived socializers' attitudes, and past performance in mathematics.[1] Previous analyses reported elsewhere (Parsons et al., 1980) uncovered some variability in these scales across the male and female samples. While there was a tendency for boys to rate their math ability as more positive than girls, these differences did not reach statistical significance. This was also true for students' perceptions of their socializers attitudes. In contrast, sex differences were found for the scale designed to measure the value of math, with boys perceiving math as more valuable and useful. No sex differences were found in students past performances in math (i.e., grades and achievement scores), current grades, or the number of courses they intended to take in high school.

The results of the regression analyses are presented in Table 1. Gender was among the three most important predictors of the anxiety reported by students. However, with the other attitudinal variables held constant, sex alone accounted for less than one percent of the variance in anxiety scores. In relation to ability and value concepts, which together accounted for 63% of the variance, the relative influence of gender is negligible. Not surprising, of these two constructs, students' ratings of their own math abilities had the strongest influence on anxiety levels. This finding was consistent across the male and female samples. It is important to note that sex differences were not found in students' perceptions of their ability, further suggesting that in this sample gender in of itself did not explain substantial variations in the affective reactions associated with mathematics.

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[1] For purposes of data reduction, the affect subscales were factor analyzed to form one general factor of negative and anxious reactions.

The final set of analyses assessed the influence of affective reactions on students' academic choices and achievement in mathematics. The analyses thus far have revealed a slight difference in boys' and girls' reactions to mathematics. A small proportion of this variation was due to gender differences and was not accounted for by any of the other attitudinal variables under consideration. Therefore, to further assess the importance of these differences, the relative influence of anxiety ratings on students' course plans and current grades in mathematics were examined.

Using multiple regression procedures, the influence of affect was tested in relation to the effects of self-perceptions of ability, perceived value, socializers attitudes, and past performance in mathematics. As is shown in Table 2, the results of this analysis revealed that in relation to ability and value concepts, the relative importance of affective reactions in explaining students course enrollment intentions was insignificant. This was also true for students' current performance in mathematics. Table 3 shows that although anxiety had a relatively weak influence on current grade, its effect was slightly stronger in the male sample. The direction of this effect indicates that in this sample, anxiety was associated with higher grades in math.

The pattern of findings support the predictions of expectancy X value theories of achievement behaviors. Students' course taking intentions are dependent on their self-estimates of ability and the value of that task or goal for them. Students who indicated they would take as much math as they could also felt they had a high math ability (i.e., expected to do well) and placed a high degree of importance and

value on a strong background in mathematics. However, to conclude that affect is not an important factor in this process would be premature at this point, given its relation to these important mediators of academic choices.

Additional analyses were thus performed to assess the indirect influence of affect on course taking intentions, using path analysis procedures. In the absence of longitudinal data to more adequately test the causal assumptions of the path model, this preliminary analysis focused on the influence of anxiety reactions on value concepts. The results of this analysis are shown in Figure 2. The pattern of influence depicted here suggests that affect makes an important contribution to students' value concepts. In this sample, it appears that the more negative students feel toward their math abilities and the subject matter, the more they lower its perceived value and importance. As previous analyses have also shown, the perceived value of math is an important predictor of course taking intentions. Also, there is suggestive evidence that affect may have a differential effect for male and female students. The affective reactions associated with mathematics appear to have a stronger influence on the value concepts of male than female students. By examining the indirect influence of affective reactions, these analyses suggest that their importance should not be minimized. Although further analyses are needed using causal modeling procedures, the affect associated with math makes an important and differential contribution to how students view its value and importance.

Conclusions

I would like to conclude by highlighting a few of the theoretical and educational implications of this study. Admittedly, this is a very practical application of achievement motivation theory and research, but many researchers are beginning to question the ecological validity of more rigorous laboratory studies for the realities of classroom life.

The results of this study suggest that the role of sex differences in achievement-related affect has perhaps been overemphasized. While there was a slight tendency for girls to feel more negative towards math, gender differences were neither as strong nor as large as what might be expected from prior research. These findings are particularly interesting in light of research showing that gender differences in the factors associated negative affective responses such as low achievement expectainers are especially marked for tasks that might be sex-typed as feminine or masculine, like mathematics (Freeze, Fisher, Hanusa, Mchugh, and Valle, 1978).

What accounts for this lack of support? The influence of sex-role factors is discussed later in this symposium. Recent evidence suggests that the familiarity of the task might be another important variable to consider. That is, sex differences in confidence, expectancies, and self-evaluations of ability are most commonly found when the achievement task is a novel and unfamiliar one (see Lenney, 1977). Certainly by the time students enter junior high school, mathematics, or at least the process of learning mathematics, is a familiar one. They also have pretty good notions of what leads to "success and failure" in these classes. It is important to bear in mind, though, that the students in our sample had average or better math abilities. But these are the

students who are most likely to have the option of continuing their mathematics education or pursuing a career in math-related fields.

In this regard, the findings of this study suggest that the degree of anxiety students experience does not necessarily inhibit achievement striving. Relative to other attitudinal factors, anxiety was not a strong predictor of either course taking intentions or current grades in mathematics.

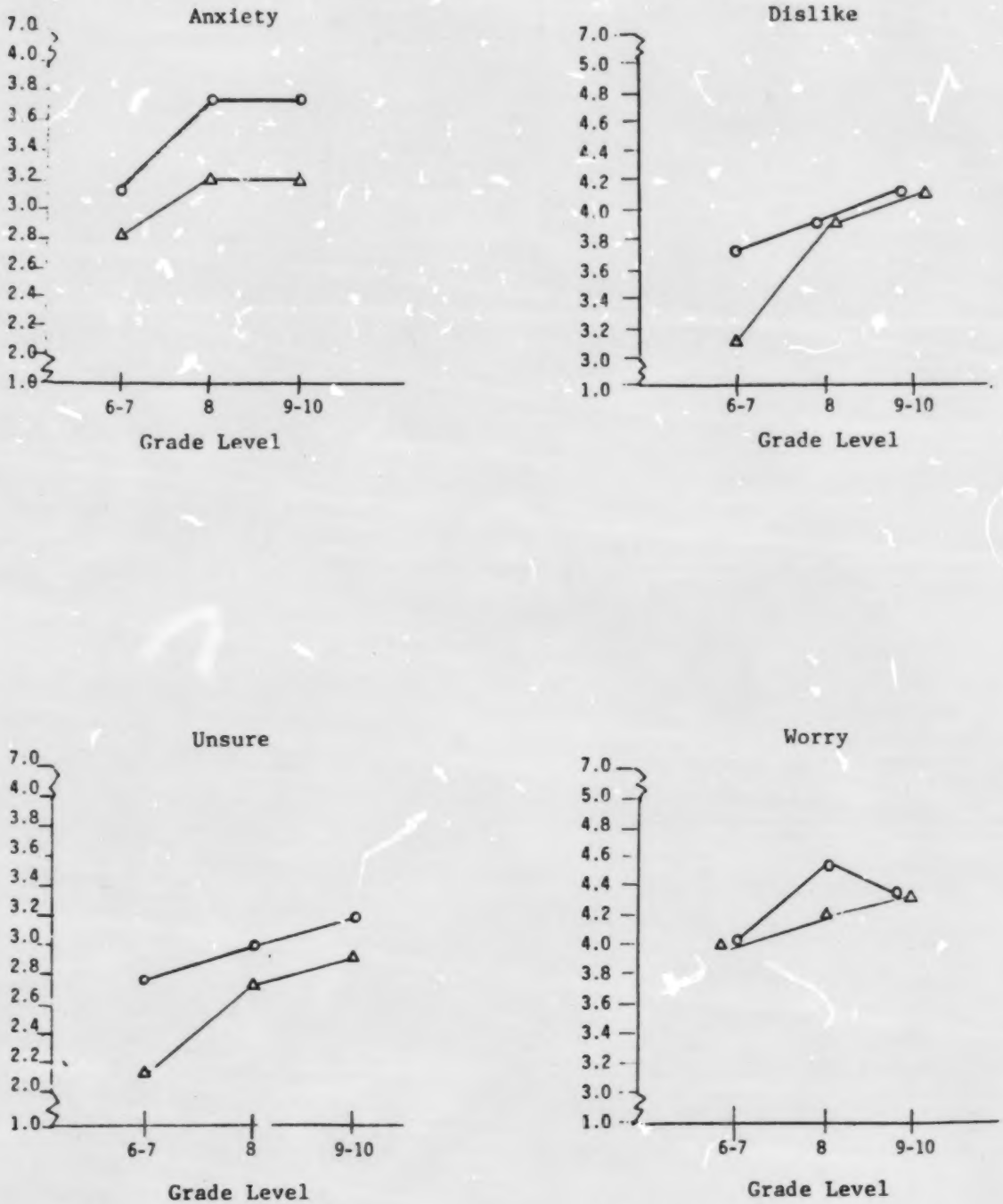
Of course, when students actually have to choose between advanced calculus or french literature, humanities may be more preferable to students who have had adversive experiences with mathematics. The data indicate that these students devalue the importance of mathematics, perhaps as a means of reducing their anxiety or protecting their sense of competence. Therefore, to more fully understand the role of affect in such decisions, it is important to go beyond reported intentions to observe actual course enrollment patterns.

In a time when many french literature majors find themselves unemployed with no "job skills," students may choose to persist even under the most adverse circumstances. This prediction, of course, assumes that students have adequate information and knowledge about the current job market and the type of training required for various occupations. Preliminary data from our research project show that this might not be a reasonable assumption and that girls seem to be the least informed about these matters. Therefore, girls indicate that mathematics has lower usefulness and utility than do boys for what they want to do after high school. This particular set of findings is consistently reported in several investigations of women's course enrollment patterns.

So where are we now? The goal of this discussion was not to discount the importance of affect in the educational process. Educators should continue to strive to make learning free of shame, worry, stress, and anxiety. However, the present study in conjunction with others, suggest that the emphasis in achievement motivation research should be shifted away from the motivational deficiencies of women such as strong motives to avoid failure and success. Instead, more attention should be given to the factors influencing value concepts. Affective experiences appears to be one of the many factors influencing the value and importance students attach to achievement activities. As several authors have suggested, we need more refined and individualistic conceptions of achievement values to more fully understand why activities come to be differentially valued. More importantly, we need a more enlightened perspective for interpreting sex differences. This argument, I hope, is not new to the members of this audience. Isn't it possible that women's reactions to mathematics are realistic and reasonable, given the ubiquity of competition and evaluation in most mathematics classes?

Figure 1

. Students Mean Ratings on Math Anxiety Scales
by Sex and Grade



o Females

Δ Males

Table 1

Results of Regression Analyses
of Students Anxiety Ratings

Predictor Variables	Males (N=113)	Females (N=127)	Total Sample (N=240)
Perceived Value	-.21*	-.19*	-.20**
Perceived Ability	-.62**	-.72**	-.64**
Perceived Socializers Attitudes	-.11	.06	-.05
Past Performance	.03	.01	-.02
Gender	---	---	-.10*
R^2	.70	.63	.67
E	.05	.06	.03

** $p \leq .001$

* $p \leq .01$

Table 2

Results of Regression Analyses of
Students Course Taking Intentions

Predictor Variables	Males (N=113)	Females (N=126)	Total Samples (N=239)
Anxiety	-.005	-.11	-.06
Perceived Value	-.31*	-.44*	-.38**
Perceived Ability	-.24	-.28	-.25
Perceived Socializers Attitudes	-.09	.08	-.02
Past Performance	-.02	-.14	-.07
Gender	---	---	.08
R^2	.31	.31	.29
E	.08	.08	.05

** $p \leq .001$

* $p \leq .01$

Table 3

Results of Regression Analyses
of Students Current Math Grades

Predictor Variables	Males (N=104)	Females (N=115)	Total Sample (N=219)
Anxiety	.13	.07	.10
Perceived Value	-.10	.05	-.02
Perceived Ability	.51**	.30	.43**
Perceived Socializers Attitudes	.17	.21	.16
Past Performance	.32**	.06	.19**
Gender	---	---	.06
R^2	.48	.24	.33
E	.07	.08	.06

** $p \leq .001$

* $p \leq .01$

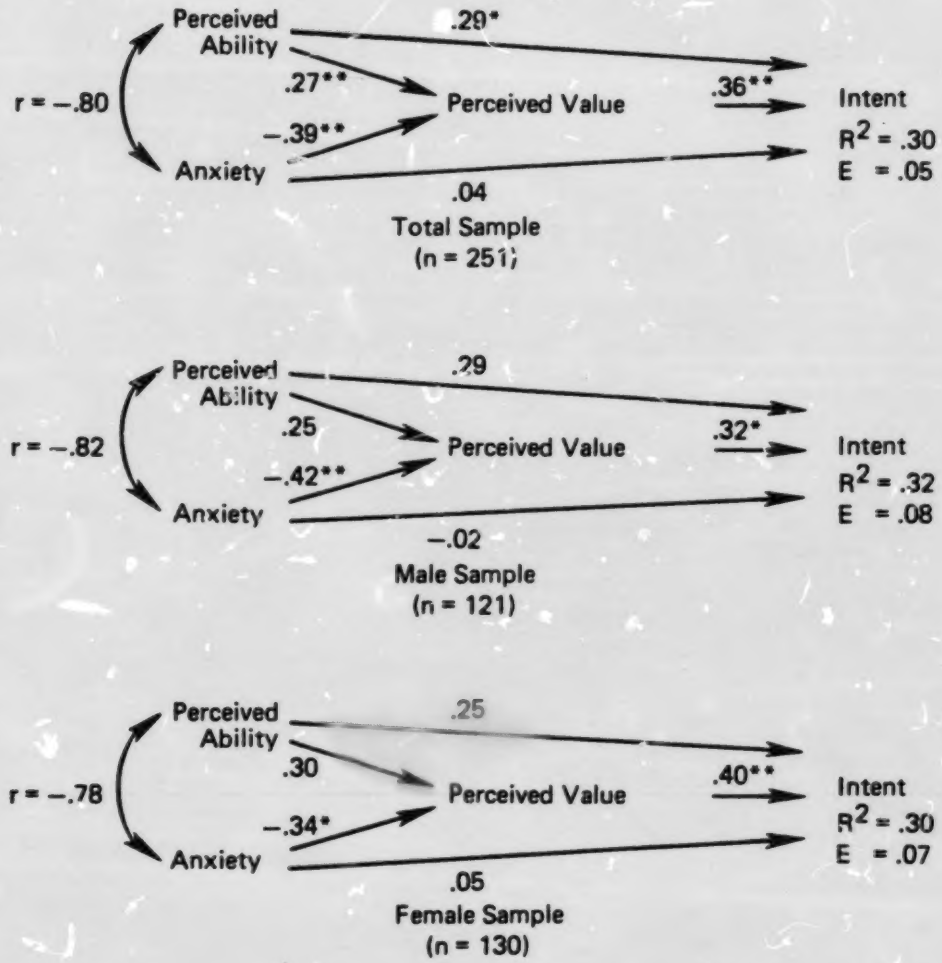


Figure 2. Analyses of indirect influence of anxiety on course taking intentions.

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